sandy, and there is some evidence of the presence of water during deposition, such as occasional sorting and bedding of the pebbles, and intercalated lenses of sandstone. There is indication of at least one brief period of cessation of till deposition, with accompanying deposition by water of a thin irregular sheet of sand and mud. By later ice movement this was over-ridden—apparently in a direction from the east toward the west—deformed and partly broken up, and a considerable further thickness of till deposited upon it. Later in the day we revisited the Hyde Park locality, where a quartzite pebble was found, imbedded in the matrix, having a well-developed "sole" or beveled face, upon which are scorings in at least two directions, the moulds of which show in the matrix.

The tillite occupies the upper portion of what has been known as the Roxbury conglomerate, and at Squantum is from 500 to 600 feet thick, and is overlain by about 60 feet of stratified conglomerate, sandstone and interbedded slate, which make the top of the Roxbury and form a transition to the overlying Cambridge slate. The possible glacial origin of the Roxbury conglomerate has been suggested by the late N. S. Shaler and others, but these are the first known discoveries in that formation of definite evidence of glacial action or of the existence of glacially deposited beds. In the absence of determinative fossils, the age of the Roxbury and Cambridge formations has never been definitely known, but they have been assigned on general grounds, chiefly the analogy of their structural relations to those of similar beds in the Narragansett Basin, to the upper part of the Pennsylvanian Series, of the Carboniferous System. In view of the accumulating evidence of glaciation in many parts of the world in Permian time, it seems a reasonable assumption that if glacial conditions prevailed in eastern New England at some time late in the Carboniferous Period, they were contemporaneous with similar conditions elsewhere, and hence that glacial deposits found in the Carboniferous rocks of the Boston region were formed in Permian time. There are no known grounds for objecting to the assignment of a Permian age to the Roxbury and Cambridge formations, and in fact such a view explains some of their observed structural relations rather better than the older view. In the opinion of Dr. Huntington, the discovery of this tillite is the best evidence yet brought to light upon the age of the Roxbury conglomerate.

The above account will be followed shortly by a more complete, illustrated article.

Robert W. Sayles,
Laurence LaForge

A CONTRIBUTION TO THE PROBLEM OF COON BUTTE

It has seemed to the writer that the chief difficulty in the way of acceptance of the volcanic origin of Coon Butte has been an assumed impossibility of breaking the grains of the gray sandstone into angular fragments by hot water action. If this can be done, the former, though now subsided, volcanic activity of the region within a few miles of the crater would give a presumption of its formation by such agency, especially as no meteorite large enough to make such a crater has been found, although searched for by Messrs. Barringer and Tilghman by means of pits and borings.

Dr. Merrill suggests that the impact of the body developed heat enough to volatilize it. This view does not seem warranted by what we know of smaller meteorites whose falls have been witnessed, but if heat of sufficient intensity to volatilize a mass of iron, say 500 feet in diameter, could be so developed it would surely leave undeniable marks in fused and metamorphosed crater walls. No such effects are to be seen.

There are some features of the crater that seem inconsistent with its formation by a projectile. The powdered sand grains come mainly from the gray sandstone lying 200 feet or more below the surface while the red sandstone cap, on which the body would have fallen, and the yellow silicious limestone next below seem chiefly to have been broken into fragments.

Again, of the powdered silica Tilghman says:

It seems to be a very general feature of the structure of the rim that the lowest material, that lying upon the top of the original surface, is a greater or less depth of this powdered rock, sometimes alone and sometimes mixed with rock fragments, and that on this rests and is supported the whole of the detrital cover which constitutes the crest and outer slopes of the rim.

This does not look like the result of a single crushing blow from above or steam explosion from beneath. From these the heavier pieces would naturally fall first, and the powdered rock settle on and around them.

It rather suggests long-continued deposition of this powder, with occasional pieces of rock, by geyser action, and a final explosion or series of explosions that closed the drama. But it has been said there is no evidence of solfataric action here. Thin sections made by the writer from what has been called "metamorphic" sandstone found in the crater, and met with in borings to a depth of 400 feet seemed to him to differ from geyserite of the Yellowstone Park mainly in enclosing particles of the powdered rock, a thing to be expected of any geyserite formed here.

In his view, however, all this mass of pulverized rock has been broken by hot water action; not, of course, by solution which would give amorphous silica, nor by a single violent steam explosion, but in part by explosion of superheated water within the pores of the rock fragments and within the grains themselves, but mainly by attrition of grains and fragments of rock churned by boiling water in geyser tubes.

Under the microscope the grains of the gray sandstone are seen to contain many minute cavities and inclusions. To test if it was possible to break up these grains by boiling water, a piece of the rock, weighing about 25 grams, was soaked for several days in distilled water and boiled for about 40 hours.

Disintegration of the cemented grains soon began and was helped from time to time by gentle pressure with the fingers. The water grew turbid with floating particles, some of them so fine that they had not settled on standing 24 hours.

The dried grains and particles were sifted on an 100-mesh sieve and 28 per cent. passed through. Of these 30 per cent. passed through an 139-mesh bolting cloth. Those passing the 139-mesh were mostly angular, those held by it were mostly rounded.

The grains held by the 100-mesh in the above test were freed from angular particles and again boiled. Gradually the water grew turbid as before. After 30 hours of boiling they were dried and again sifted on the 100-mesh. About 4 per cent. passed through, and of these 11 per cent. passed the 139-mesh. Those passing the 139-mesh were mostly angular, those held by it, for the most part, rounded.

To test if the grains could be blown apart by steam generated within them, grains held by the 100-mesh were freed from angular fragments, boiled a few minutes to expel air, sealed with water in a glass tube, and this heated in a steel tube to explosion.

The sifted débris gave many angular fragments of grains that passed the 139-mesh along with much powdered glass easily distinguished not only by its behavior between crossed nicols, but by the greater sharpness of its angles and its clearness, the quartz fragments, as a rule, being clouded with inclusions and cavities.

To avoid risk of breaking the quartz grains against the steel tube the experiment was repeated with the glass tube loosely wrapped in asbestos paper. The result was as before.

These simple experiments seem to show that no other agent than hot water and the explosive power of steam is needed to produce all the phenomena of Coon Butte.

Geyser tubes coming up through this loosely coherent sandstone, loosening grains and pieces, filling their cavities with superheated water, carrying them up to where diminished pressure let the water explode in steam, bursting some, churning them in the tubes, would in time carry up and deposit these millions of tons of grains and fragments of grains, and with stoppage of the vents, perhaps by sinking of the overlying rocks, would come the ex-

plosion or series of explosions that wrecked the geyser field.

That here the result of geyser action has been powdered sand grains rather than geyserite, as at the Yellowstone, would be due to the different kinds of rock at the two places.

Underlying Yellowstone Park are compact, igneous rocks. They would be gradually dissolved by hot alkaline water with formation of geyserite.

At Coon Butte the underlying rocks are loosely coherent sandstones whose grains would be carried up bodily, and solvent action would be relatively less.

Other things being equal, the time required to carry up the sand grains and fragments at Coon Butte would be much less than that required to dissolve an equal amount of rock at the Yellowstone Park and to deposit it in the form of geyserite.

JOHN M. DAVISON

PITTSFORD, N. Y.,
August 23, 1910

BLACK LEG OR PHOMA WILT OF CABBAGE: A NEW TROUBLE TO THE UNITED STATES CAUSED BY PHOMA OLERACEA SACC.

WITHIN the past few years there has appeared in the cabbage districts of Clyde and Fremont, Sandusky Co., Ohio, a cabbage and cauliflower disease apparently new in the United States. The disease has been under the observation of the writer since June of the present season. Field symptoms together with the determination of the causal fungus show the disease to be identical with that known in Holland as "Fallsucht" (drop disease or falling sickness). J. Ritzema Bos, in *Zeitschrift fur Pflanzenkrankheiten,* Band 16, pp. 257–276, 1906, has fully described this disease and states the trouble is due to the fungus *Phoma oleracea* Sacc. He further describes a storage disease of cabbage known as "Krebsstrunke" (stem cancer) brought about by the same organism.

What appear to be similar diseases to the above have been noted by Prillieux[1] to occur in the forage cabbage districts of the province of Vendée, in western France, and by D. McAlpine[2] in the cabbage and cauliflower districts of South Australia. Both of these writers assign *Phoma Brassicæ* Thüm. as the causal agent.

The diseases as described by Prillieux and McAlpine are quite similar to that described in Holland and to that found in Ohio. The former calls the trouble "Pourriture des pieds de Chou," that is, "foot rot of cabbage," and the latter designates the disease "black leg or foot rot of cabbage and cauliflower."

According to Bos (see citation above) and Quanjer[3] there is reason to believe that the organism assigned by Prillieux as the cause of the disease, is identical with *Phoma oleracea* Sacc.

The disease is quite important in each of the countries noted. In South Australia, according to McAlpine, it "is perhaps the most serious trouble with which the grower has to contend." He does not mention the presence of black rot or the *Fusarium* wilt.

Symptoms.—The work of the disease is early to be observed in the infected seed beds, being often conspicuous one or two weeks prior to transplanting. The preliminary symptom is that of white, slightly sunken, elongated oval areas on the stem usually below the point of leaf attachment. Occasionally the disease spots occur on the leaves. There appear early in these lesions small, black pycnidia equally, though somewhat sparingly, distributed over the affected areas. Each pycnidium contains myriads of spores which are evidently the source of a rapid dissemination of the disease at the time of transplanting.

In the early stages of the disease the fungus may be plated out in pure culture as the sole occupant of the lesion. Later the lesion breaks and bacterial decay sets in. In the

[1] "Maladies des Plantes Agricoles," Vol. II., p. 295, 1897.

[2] "Fungus Diseases of Cabbage and Cauliflower in Victoria, and their Treatment," Dept. of Agr., Victoria, January, 1901.

[3] *Zeitschrift für Pflanzenkrankheiten*, Band 17, 1907, pp. 259–267.